

COORDINATE GEOMETRY CONCEPTS

COGO Intrinsic Precision

There is a very small section of the GEOPAK manual, which is often overlooked. Yet prudent usage of the features documented there add significantly to the power and flexibility of GEOPAK COGO. Although they are covered in the Beginning GEOPAK Course, they are covered here in more detail. Since the concepts here are somewhat complex, they must be practiced in order to be learned well enough to use them regularly.

The word “slot” used in the following context refers to pieces of the COGO command. For example a locate command

LOCATE n (TRAVERSE) pa (DISTANCE) distance direction (OFFSET offset)

The words and letters in lower case represent user-supplied values. n and pa are points, the distance , direction, and offset are real numbers. As you will see shortly, you can fill in these values by referring to other points. So when you use an integer number to refer to pa, the integer goes in that “slot”.

Referring to Bearings or Distance from Previously Stored Points

If two or more points are already stored in the .gpk file, you may name a bearing or distance by referring to these pre-existing points. For example, you know that point 2 lies N 32 57 18.32 E from point 1 at a distance of 273.110. If you want to locate point 3 from point 2 at that same bearing. You could enter

LOC 3 2 100.00 N 32 57 18.32 e

It would be simpler, though, to enter the bearing by referring to the existing point:

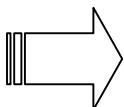
LOC 3 2 100.00 1 to 2

In this example, the text “1 to 2” is interpreted by GEOPAK as the bearing from 1 to 2 because it is the bearing “slot”.

If you put the “1 to 2” statement in the distance “slot” of the command, it will be interpreted as a distance.

LOC 4 3 1 to 2 s 80 w

“1 to 2” in this line would be interpreted as a distance of 273.110



LOC 4 3 1 to 2 1 to 2

“1 to 2” in this line would be interpreted as a distance in that “slot” and bearing in that “slot”

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Arithmetic in Bearings and Distances

You can put arithmetic in the bearing and the distance “slot”. Although you can multiply and divide, the most useful forms for us are the P for plus and M for minus. Since GEOPAK is free form notation, you can use arithmetic to modify regular bearing notations such as

N 17 56 01.12 w m 90

This equals

S 72 03 58.88 w

Or you can combine the point to point method with arithmetic. If for example, the bearing from point 11 to 43 equals N 45 E then

11 to 43 p 10 is interpreted by GEOPAK as N 55 E.

Naming Points for Curves and Spirals

GEOPAK curve elements and GEOPAK spiral elements each has “intrinsic value points”, which are stored in the .gpk file each time one of these elements is stored. For example, every curve has a PI. By virtue of the fact that the PI has a northing and easting, it is a point. *(The same is true for the point of curve PC, the point of tangent PT, every point on the curve POC, the center of the curve or radius point CC.)* This means you can use a PI (or any other intrinsic point) in the same way as you use other points. The great advantage of this is that these points automatically change when the element they define change. This can be a time saver if you are in the process of developing an alignment.

At the time of this writing of this course outline, intrinsic point reference is not in the GEOPAK manual. Here is a list of intrinsic points and syntax for curves.

<u>Intrinsic Point</u>	<u>Syntax</u>
Curve PI	<i>PI name</i>
Curve PC	<i>PC name</i>
Curve PT	<i>PT name</i>
Curve Center	<i>CC name</i>
Spiral TS	<i>TS name</i>
Spiral SC	<i>SC name</i>
Spiral CS	<i>CS name</i>
Spiral ST	<i>ST name</i>
Spiral PI	<i>PIS name</i>

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The items in the syntax column are what go into the point “slot” in any GEOPAK command. For example, one could say

LOC 12 from 5 DIS 53.001 s 17 26 w

Where 5 is in the pa “slot”. If the need were there, you could then write

LOC 12 PT YC2 53.001 s 17 26 w

in which (PT y2C2) is now in the pa “slot”.



The statement, locate point 12 at a distance of 53.001 units, from PT of curve Y2C2 at a bearing of S 17 26 W. if the location of curve Y2C2 changes at a later time for some reason, point 12 does not automatically follow it. The command must be re-read. However, after the re-reading takes place the relationship is restored.

Putting It All Together

Taken separately, the two topics of “arithmetic in Bearings and Distances” and “Naming Points from Curves and Spirals” are rather limited. However, when the two are used in conjunction with each other, their power and utility become evident.

Here is how it works. Point to point syntax used in a Bearing (or Distance) “slot” as {pa to pb}. As we learned, intrinsic can be put into point “slots”. So to refer to the “direction ahead” bearing on a pre-existing curve (named LC3), you can say “PI LC3 TO PT LC3”. To refer to the long chord distance of curve RBC1, enter “PC RBC1 TO PT RBC1” in a command’s distance “slot”.

Below is a list of curve and spiral components and the syntax to use at the COGO command line.

<u>Command</u>	<u>Syntax</u>
Curve back tangent	PC <i>name</i> TO PI <i>name</i>
Curve Ahead Tangent	PI <i>name</i> TO PT <i>name</i>
Line from PC to Curve Center	CC <i>name</i> TO CC <i>name</i>
Line from Curve Center to PC	CC <i>name</i> TO PC <i>name</i>
Type I Spiral Long Tangent	TS <i>name</i> TO PIS <i>name</i>
Type I Spiral Short Tangent	PIS <i>name</i> TO SC <i>name</i>
Type II Spiral Short Tangent	CS <i>name</i> TO PIS <i>name</i>
Type II Spiral Long Tangent	PIS <i>name</i> TO ST <i>name</i>

A simple example – one form of the curve command is as follows

STO CUR name PC pa DB direction R radius P/M DEF delta

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Let us say you are building an alignment and you already have curve RCC1 stored. You now want to store RCC2 with a PRC from RCC1. From other design decisions, $R = 150$ and $\Delta = 11$ degrees and 30 minutes right. In order to utilize the COGO Intrinsic Precision techniques here you could store RCC2 with the statement.

**STO CUR RCC2 PC PT RCC1 DB PI RCC1 TO PT RCC1 R 150
DEF 11 30**

Compare this statement with the general form found on page 14 of the curve information. We used Option 1 for the back tangent reference.

An example of intrinsic values to store a curve with only five known points: The PC, PI, PT, a point on the curve, and the radius point.

Stored point 1 is the PC
Stored point 2 is the PI
Stored point 3 is the PT
Stored point 4 is point on the curve
Stored point 5 is the radius point

[1]STOre CURve name [2]Back Tangent reference [3]Element
[4A or 4B]Ahead Tangent Reference [5]STation Station label station

STO CUR CC3 PC 1 DB 1 TO 2 RAD 1 TO 5 DA 2 TO 3 STA 4+00

THE BACK TANGENT IS DEFINE PC 1 DB PC TO PI "1 TO 2"
RADIUS IS FROM PC TO THE CENTER OF THE CURVE (CC) "1 TO 5"
AND THE AHEAD TANGENT REFERENCE (DA) IS PI TO PT "2 TO 3"
OR DA IS POINT AHEAD "PA 3"